

SECTION 02653

TESTING AND DISINFECTING WATER MAINS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work of this section includes, but is not limited to:

1. Hydrostatic leakage testing
2. Disinfecting Water Main Pipelines.
3. Bacteriological Testing
4. Disinfection after repairing an existing main

B. Related work specified elsewhere:

- | | | |
|----|----------------------------|---------------|
| 1. | Water Mains: | Section 02615 |
| 2. | Valves and Fire Hydrants: | Section 02640 |
| 3. | Water Service Connections: | Section 02642 |

C. Definitions: NONE

D. Applicable Standard Details: NONE

1.02 QUALITY ASSURANCE

A. Testing Agency:

1. Hydrostatic testing will be performed by the Contractor.
2. Bacteriological testing shall be performed by a testing laboratory engaged and paid for by the Contractor and approved by the Municipality.

B. Reference Standards:

1. American Water Works Association (AWWA):
B300 Standard for Hypochlorites
B301 Standard for Liquid Chlorine
C651 Disinfecting Water Mains

C. Test Acceptance:

1. No test will be accepted until the results are within the specified limits.
2. The Contractor shall, at his own expense, determine and correct the sources of leakage and retest until successful test results are achieved.

1.03 SUBMITTALS

A. Test Procedures:

1. Submit a testing sequence schedule including a list of testing equipment to be used.

B. Certificates:

1. Submit, prior to starting testing, certification attesting that the pressure gauges to be used have been calibrated and are accurate to the degree specified herein.
2. Submit certification attesting that the chlorine form composition is as specified.

C. Test Reports:

1. Submit two copies each of test reports of chlorine residual and bacteriological tests.

1.04 JOB CONDITIONS: Section not utilized.

PART 2 - PRODUCTS

2.01 HYDROSTATIC TEST EQUIPMENT

High pressure water pump
Pressure hose
Test connections
Water meter
Pressure gauge, calibrated to 0.1 lbs./sq. in.
Pressure relief valve

2.02 DISINFECTING CHEMICALS

- A. Liquid chlorine (gas at atmospheric pressure) or sodium hypochlorite solutions conforming to AWWA Standards B300 and B301.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Backfill trenches in accordance with Section 02221.
- B. Provide the water line under test with reaction thrust blocking. Hydrostatic testing shall not begin until the concrete thrust blocking has set. Allow 3000 psi 28-day strength concrete to cure for a minimum of 7 days prior to testing. If 3000 psi 3-day high early strength concrete is used, hydrostatic testing may not begin until the concrete has cured for a minimum of 2 days.

- C. Provide water, pumps, piping, tanks, connections, plugs, and appurtenances at no additional expense to the Municipality.

3.02 TESTING PRESSURE PIPELINES

A. Hydrostatic Test:

1. Test each newly laid pressure pipeline, including any valved section thereof, hydrostatically at 1.5 times the working pressure of the pipeline based on the elevation of the lowest point in the pipeline corrected to the elevation of the test gauge. Test pressure will not exceed twice the rated pressure of gate valves or hydrants within test section. Obtain test pressure from the Municipality.
2. Slowly fill the section to be tested with water, expelling air from the pipeline at the high points. Install corporation stops at high points if necessary. After all air is expelled, close air vents and corporation stops and raise the pressure to the specified test pressure. Duration of pressure test is one hour.
3. Observe all exposed pipe, fittings, valves, hydrants, and joints during the test. Remove and replace cracked or damaged pipe, joints, fittings, and valves showing visible leakage. Retest.

B. Leakage Test

1. After visible deficiencies are corrected, continue testing at the same test pressure for an additional two hours to determine the leakage rate. Maintain pressure within plus or minus 5.0 psi of test pressure. Leakage is defined as the quantity of water that must be supplied into the newly laid pipe to maintain pressure within 5.0 psi of the test pressure after the air in the pipeline has been expelled and the pipe filled with water.
2. Compute the maximum allowable leakage by the following formula:

$$L = \frac{ND(P)^{0.5}}{7,400}$$

Where: L is the allowable leakage in gallons/hour
N is the number of joints in the section tested
D is the nominal diameter of the pipe in inches
P is the average test pressure in psig

When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in. of nominal valve size shall be allowed.

If the line under test contains sections of various diameters, the allowable leakage shall be the sum of the computed leakage for each size.

3. If the test of the pipe indicated leakage greater than that allowed, locate the source of the leakage, make corrections and retest until leakage is within allowable limits.

4. Correct visible leaks regard-less of the amount of leakage.

3.03 DISINFECTION

A. Preliminary Flushing

1. Prior to chlorination, the main shall be flushed as thoroughly as possible with the water pressure and outlets available. Flushing shall be done after the pressure test is made.
2. If no hydrant is installed at the end of the main, a tap shall be provided large enough to effect a velocity in the main of at least 2.5 fps.
3. The rate of flow required to produce this velocity in pipes of various diameters is shown in the following table.

REQUIRED OPENINGS TO FLUSH PIPELINES
(40 psi Residual Pressure)

Pipe Size (in.)	Flow Required To Produce 2.5 fps Velocity (gpm)	Orifice Size (in.)	Hydrant Outlet Nozzles	
			Number (in.)	Size (in.)
4	100	15/16	1	2-1/2
6	220	1-3/8	1	2-1/2
8	390	1-7/8	1	2-1/2
10	610	2-15/16	1	2-1/2
12	880	2-13/16	1	2-1/2

4. All hydrants on the lines shall be thoroughly flushed and carefully inspected after flushing to see that the entire valve operating mechanism of each hydrant is in good condition and that small stones or other foreign material is not lodged therein.
5. No site for flushing should be chosen unless it has been determined that drainage is adequate at that site.

B. Chlorine Application

1. The form of chlorine used in the disinfecting solutions shall be either liquid chlorine (gas at atmospheric pressure), or sodium hypochlorite solution.

- a. Liquid Chlorine shall be used only when suitable equipment is available and only under the direct supervision of a person familiar with the physiological, chemical, and physical properties of this element and who is properly trained and equipped to handle any emergency that may arise.

Introduction of chlorine-gas directly from the supply cylinder shall not be permitted. The equipment shall consist of a solution feed chlorinator in combination with a booster pump for injecting the chlorine/gas/water mixture into the main to be disinfected. Direct feed chlorinators are not permitted.

- b. Sodium hypochlorite is supplied in strengths from 5.25 to 16 percent available chlorine. It is packaged in liquid form. The chlorine-water solution is prepared by adding hypochlorite to water.

The hypochlorite solutions shall be applied to the water main with a gasoline or electrically-powered chemical feed pump designed for feeding chlorine solutions. For small applications the solutions may be fed with a hand pump, for example, a hydraulic test pump. Feed lines shall be of such material and strength as to withstand safely the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the hypochlorite solution is applied to the main.

- 2. The preferred point of application of the chlorinating agent shall be at the beginning of the pipeline extension or any valved section of it and through a corporation stop inserted by the Contractor in the top of the newly laid pipe. In a new system, application of chlorine may be made advantageously at a pumping station, elevated tank, standpipe, or reservoir.
- 3. Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly-laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 50 mg/l available chlorine.
- 4. During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution.
- 5. The chlorinated water shall be retained in the main for at least 24 hours during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24-hours period, the treated water shall contain no less than 25 mg/l chlorine throughout the length of the main.

2. Chlorine residual determination shall be made in accordance with the procedures described in the current edition of Standard Methods and AWWA M12-Simplified Procedures for Water Examination, to ascertain that the heavily chlorinated water has been removed from the pipeline.

D. Bacteriologic Tests

1. After final flushing, and before the water main is placed in service, at least two samples shall be collected at least 24 hours apart from the end of the line and tested for bacteriologic quality and shall show the absence of coliform organisms. Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulphate. No hose or fire hydrant shall be used in collection of samples.
2. A suggested sampling tap consists of a standard corporation stop installed in the main with a copper tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.
3. If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. The tablet method cannot be used in these subsequent disinfections. When the samples are satisfactory, the main may be placed in service.

3.04 DISINFECTION AFTER CUTTING INTO OR REPAIRING EXISTING MAINS

- A. Leaks or breaks that are repaired with clamping devices while the mains remain full of water under pressure require no disinfection.
- B. When an existing line is opened, either by accident or by design, the trench shall be "treated" to minimize the likelihood of contamination of the main by trench water. Liberal quantities of hypochlorite shall be applied to open trench areas. Tablets are preferred in such a situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.
- C. The interior of all pipe and fittings used in making the repair (particularly couplings and tapping sleeves) shall be swabbed with a five percent hypochlorite solution before they are installed.
- D. Bacteriologic samples shall be taken after repairs to provide a record by which the effectiveness of the procedures used can be determined. If the direction of flow is unknown, samples shall be taken on each side of the main break.

END OF SECTION